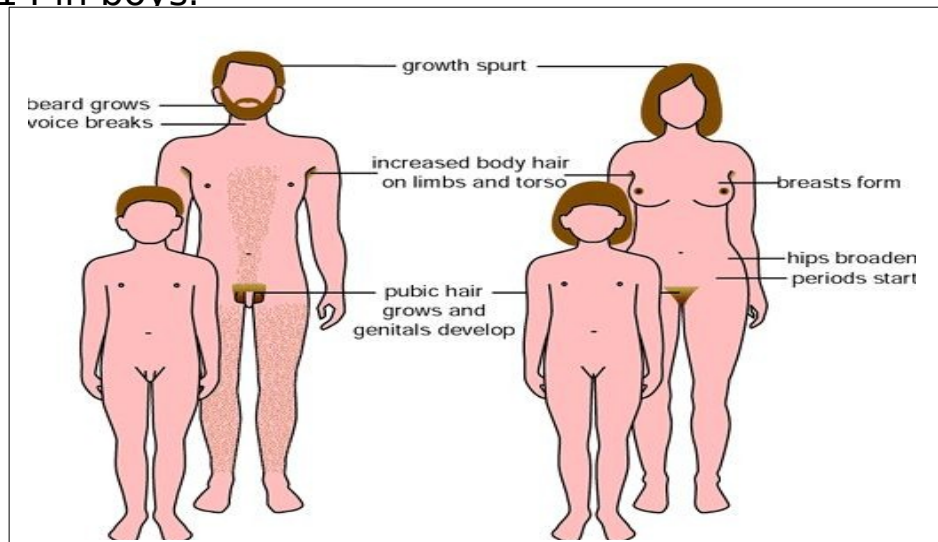


Physiology of puberty, pregnancy

- The gonads of both sexes are inactive until they are activated by gonadotropins from the pituitary to bring about the final maturation of the reproductive system. This period of final maturation is known as adolescence. It is often also called puberty.

Pubert

- It is the period when the endocrine and gametogenic functions of the gonads have first developed to the point where reproduction is possible.
- Puberty generally occurs between the ages of 8 and 13 in girls and 9 and 14 in boys.



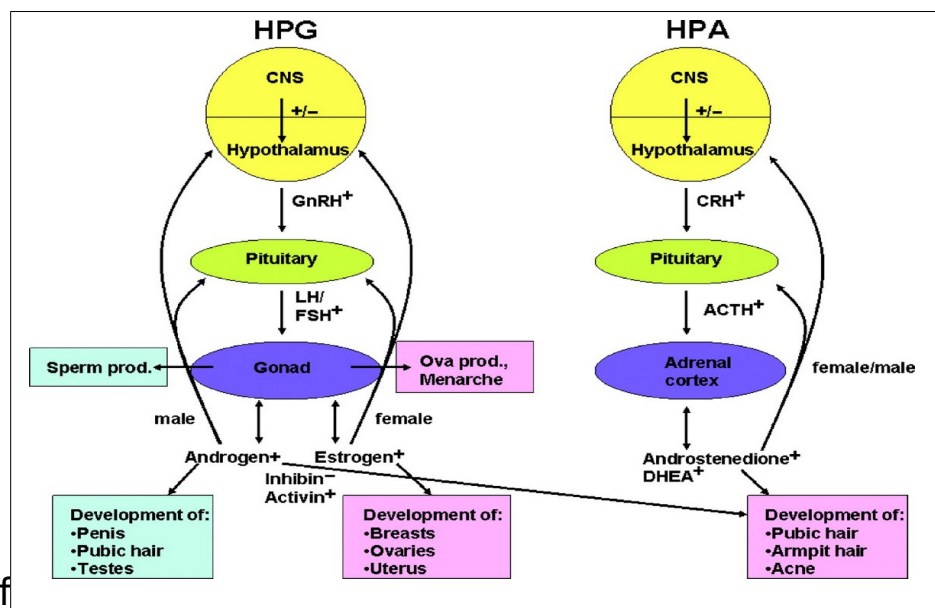
- 1- In girls: the first event is **thelarche**, the development of breasts, followed by **pubarche**, the development of axillary and pubic hair, and then by **menarche**, the first menstrual period. Initial menstrual periods are generally anovulatory, and regular ovulation appears about a year later.
- 2- In boys: enlargement of the testes, penile enlargement, growth of the glans penis and finally adult genitalia.

- Another event that occurs in humans at the time of puberty is an increase in the secretion of adrenal androgens. The onset of this increase is called **adrenarche**. Dehydroepiandrosterone (DHEA) values peak at about age 25 in females and slightly later than that in males. They then decline slowly to low values in old age. The rise appears to be due to an increase in the activity of **17 β -hydroxylase**.

The maturation of gonads is accompanied by:

- Acceleration of growth (growth spurt).
- Development of secondary sexual characteristics.

➤ Control of the onset of puberty:



- The f... birth until puberty because the hypothalamic GnRh is suppressed. A neural mechanism is operating to prevent the normal pulsatile release of GnRH. The nature of the mechanism inhibiting the GnRH pulse generator is unknown.
- Puberty is initiated mainly by pulsatile secretion of GnRH at the age of puberty.
- The increase in GnRH that occurs at the time of puberty may be due to decrease secretion of the hormone melatonin, which is

secreted by the pineal gland in the brain. Melatonin has an antigonadotropic effect.

- It now appears that leptin, the satiety-producing hormone secreted by fat cells, may be the link between body weight and puberty. For example, young women who engage in strenuous exercises lose weight and stop menstruating, as do girls with anorexia nervosa.

➤ **Precocious and delayed puberty:**

1. Sexual Precocity:

- Precocious pseudopuberty: Early development of secondary sexual characteristics without gametogenesis is caused by abnormal exposure of immature males to androgen or females to estrogen.
- True precocious puberty: Early but otherwise normal pubertal pattern of gonadotropin secretion from the pituitary.

2. Delayed puberty:

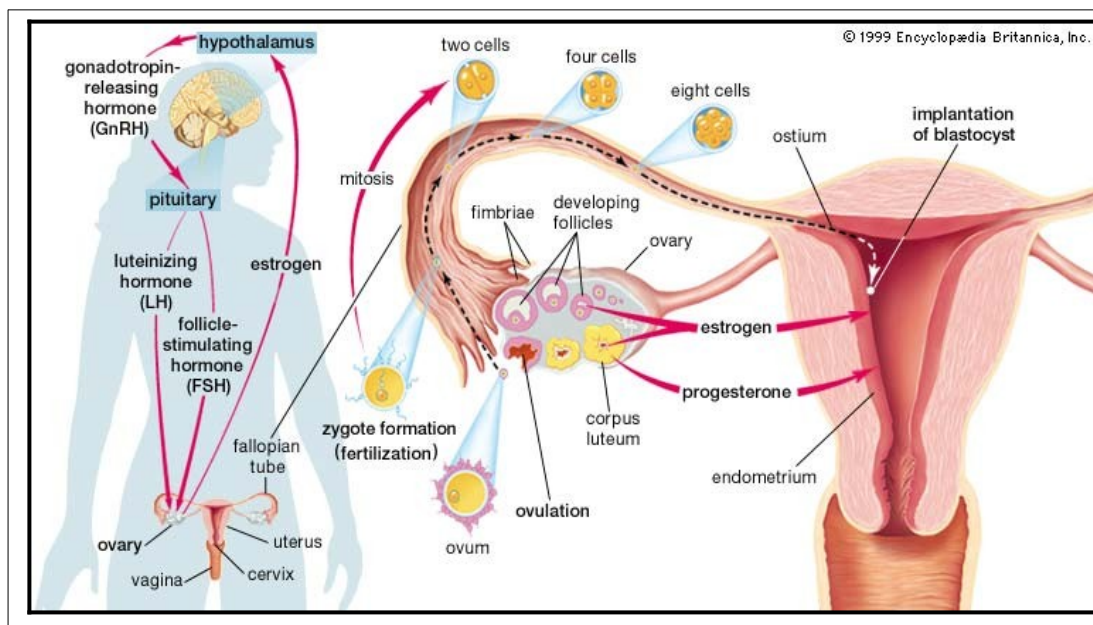
Puberty cannot be considered to be pathologically delayed until the menarche has failed to occur by the age of 17 or testicular development by the age of 20. In males, this clinical picture is called eunuchoidism. In females, it is called primary amenorrhea. It may be caused by panhypopituitarism or Turner syndrome

Pregnancy

➤ **Endocrine changes in pregnancy:**

- In all mammals, the corpus luteum in the ovary at the time of fertilization fails to regress and instead enlarges in response to stimulation by gonadotropic hormones secreted by the placenta.

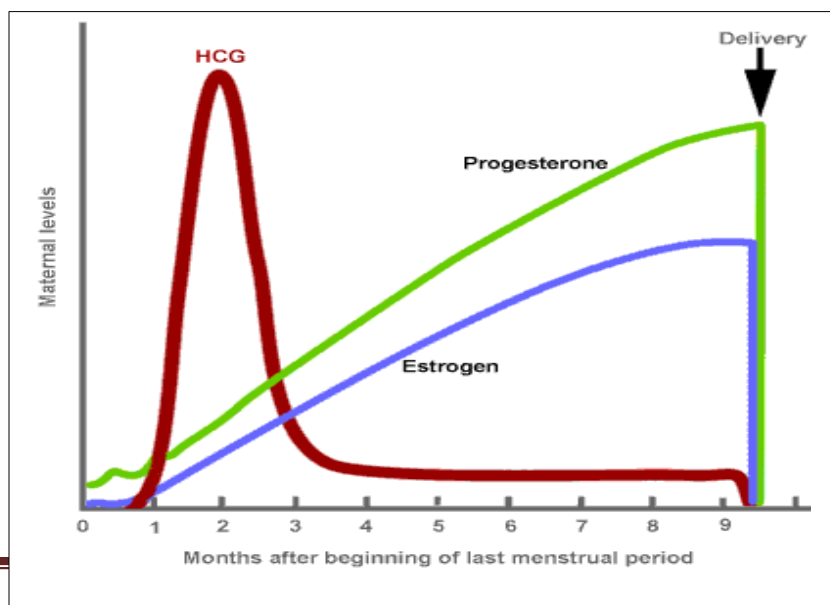
- The placental gonadotropin in humans is called **human chorionic gonadotropin (hCG)**.
- The enlarged corpus luteum of pregnancy secretes **estrogens**, **progesterone**, and **relaxin**.
- After the sixth week of pregnancy, the placenta produces sufficient estrogen and progesterone from maternal and fetal precursors to take over the function of the corpus luteum. Therefore, ovariectomy before the sixth week leads to abortion, but ovariectomy thereafter has no effect on the pregnancy. The function of the corpus luteum begins to decline after eighth week of pregnancy, but it persists throughout pregnancy.
- hCG secretion decreases after an initial marked rise, but estrogen and progesterone secretion increase until just before parturition.



Placental hormones

1- Human Chorionic Gonadotropin (hCG):

- hCG is a glycoprotein produced by the syncytiotrophoblast.
- Like the pituitary glycoprotein hormones, it is made up of and subunits. hCG- is identical to the subunit of LH, FSH, and TSH. hCG is primarily luteinizing and luteotropic and has little FSH activity.
- It can be measured by radioimmunoassay and detected in the **blood** as early as 6 day after conception. Its presence in the urine in early pregnancy is the basis of the various laboratory tests for pregnancy, and it can sometimes be detected in the **urine** as early as 14 day after conception. It appears to act on the same receptor as LH.
- hCG is not absolutely specific for pregnancy. Small amounts are secreted by a variety of gastrointestinal and other tumors in both sexes.



Functions of hCG:

- 1- It prolongs the life span of corpus luteum → ↑ progesterone, estrogen & relaxin → to *maintain pregnancy* until the placenta is formed at 12th week.
- 2- *In the male fetus*, HCG synthesis of testosterone ⇒ development of male internal genitalia & for descent of the testicles into the scrotum.
- 3- hCG → (+) the CTZ in the vomiting centre → vomiting in early morning (*morning sickness*).

2- Human Chorionic Somatomammotropin (hCS) = human placental lactogen (hPL):

- It is secreted by syncytiotrophoblast. The amount of hCS secreted is proportionate to the size of the placenta, which normally weighs about one-sixth as much as the fetus, and low hCS levels are a sign of placental insufficiency.

Functions of hCS:

- 1- ↓ insulin sensitivity, ↓ maternal glucose utilization making more glucose available to the fetus.
- 2- Lipolytic → ↑ free FAs to be used as a fuel by the mother sparing glucose to fetus.
- 3- Lactogenic and has a small amount of growth-stimulating activity.

3. Placental progesterone:

- It is secreted at first by corpus luteum then by the placenta.

Functions: *It is essential for continuation of pregnancy.*

1. Maintains secretory function of endometrium which promotes nutrition of the embryo.
2. Suppress the contractions of the myometrium (*because it decreases the number of oxytocin receptors and decreases some prostaglandins*) so, prevent spontaneous abortion.
3. Stimulates breast development (alveoli) to prepare for lactation.

4. Placental estrogen:

- It is secreted at first by corpus luteum then by the fetoplacental unit.

Functions:

1. Stimulates the growth of endometrium.
2. Stimulates contraction of myometrium (*increase the number of oxytocin receptors and amount of contractile proteins*) So, helps in expulsion of fetus during labor.
3. Stimulates breast enlargement (duct system).
4. Helps enlargement of external genitalia.

5. Relaxin hormone:

- It is secreted at first by corpus luteum then by the placenta

Functions: facilitate delivery of baby

1. Relaxation the symphysis pubis & pelvic ligaments.
2. Softening & ripening of cervix.
3. Increases the number of oxytocin receptors, thus making the uterus more sensitive to oxytocin.

PARTURITION (Labor)

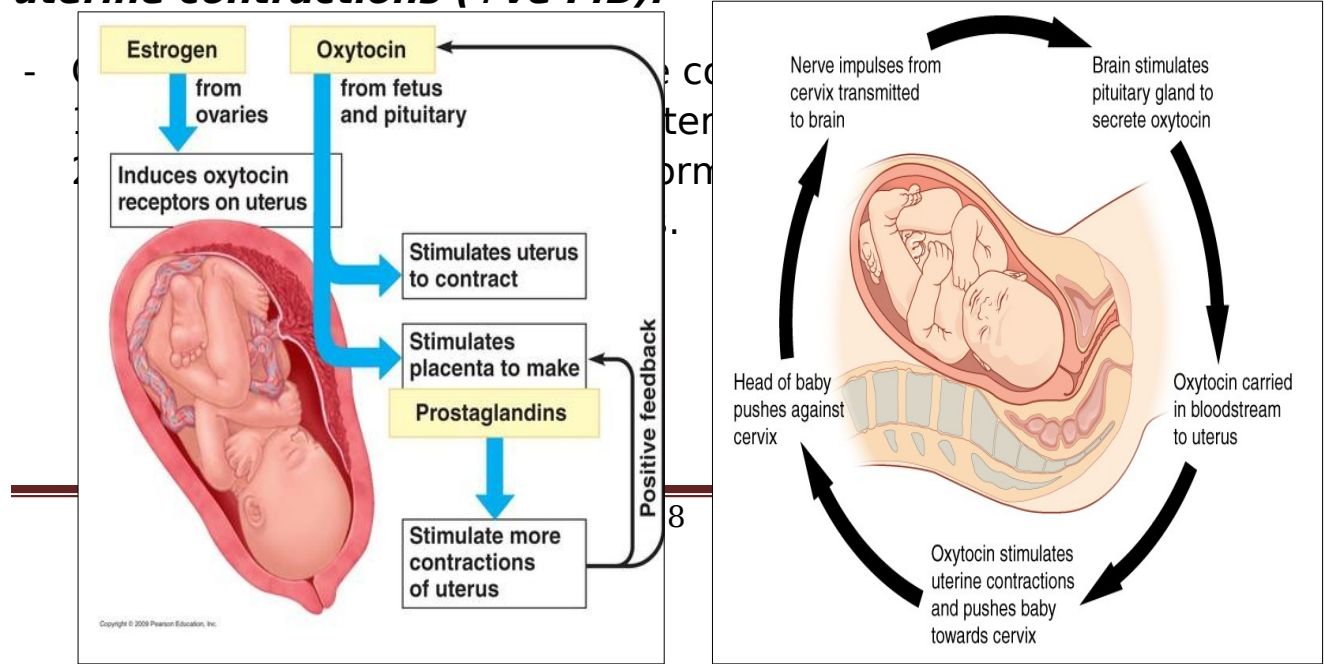
- Parturition is the process by which the baby is born.
- It requires:

1. Dilatation of the cervical canal.
2. Contraction of the uterus to force the fetus to outside

- Initiation of parturition (mechanism):

- In the first 2 trimesters (in first 6 months) the high level of progesterone inhibits uterine contraction.
- During the last trimester the uterus becomes more excitable and weak contractions occur, which gradually increases in strength and frequency towards the end of pregnancy. The number of oxytocin receptors in the myometrium increases gradually in late pregnancy and during early labor due to high estrogen level.
- Oxytocin plays an important role in initiation and progress of labor by stimulating strong regular frequent contractions.
- These contractions are caused by:
 1. Increase of estrogen progesterone ratio.
 2. Mechanical stretch of the uterus by the growing fetus.
 3. Irritation or dilatation of the cervix, which also causes reflexes that lead to oxytocin secretion

Cervical dilatation ⇒ (+) of mechanoreceptors in cervix ⇒ afferent fibers in spinal cord ⇒ (+) of hypothalamus to release oxytocin from posterior pituitary into blood ⇒ (+) uterine contractions (+ve F.B).



Hormonal control of parturition:_

1. Oxytocin:

- Cervical dilatation \Rightarrow (+) of mechanoreceptors in cervix \Rightarrow afferent fibers in spinal cord \Rightarrow (+) of hypothalamus to release oxytocin from posterior pituitary into blood \Rightarrow (+) uterine contractions (+ve F.B).
- It uterine contractions both direct & through PGs.
- no. of oxytocin receptors is ed by estrogen & relaxin.

2. Prostaglandins:

- Released from myometrium in response to oxytocin & also from placenta \Rightarrow through a paracrine action \Rightarrow (+) uterine contractions.

3. Relaxin hormone:

- increase the number of oxytocin receptors.
- Softens the cervix.
- Relaxation of the pelvic ligaments.

4. Estrogen:

- increase the number of oxytocin receptors.
- increase the amount of contractile proteins._

Menopause

- It is cessation of sexual cycles with advancing age due to decline in ovarian function (unresponsiveness to gonadotropins).

- It is usually between the ages of 45 and 55.

- **Cause:**

1- This unresponsiveness is associated with a decline in the number of primordial follicles. Also, the ovaries no longer secrete 17-estradiol and progesterone.

2- As the negative feedback effect of estrogens and progesterone is reduced, secretion of FSH is increased, and plasma FSH and LH levels are high.

- **Manifestations:**

1- Atrophy of the 2ry sex organs e.g uterus and the vagina gradually become atrophic.

2- Regression of secondary sexual characters.

3- Hot flushes (occur in 75% of menopausal women and they are prevented by estrogen treatment. Their cause is unknown. However, they coincide with surges of LH secretion. LH is secreted in episodic bursts at intervals of 30 to 60 min or more. However, LH itself is not responsible for the symptoms, because they can continue after removal of the pituitary. Instead, it appears that some estrogen-sensitive event in the hypothalamus initiates both the release of LH and the episode of flushing.

4- Osteoporosis.

N.B:

In women, a period called perimenopause precedes menopause, and can last up to 10 y. During perimenopause the menses become irregular and the level of inhibin decrease.